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metric measures

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40 NAYE PAISE

THE PUBLICATIONS DIVISION

ABBREVIATIONS FOR METRIC UNITS

(1) DECIMAL MULTIPLES AND SUBMULTIPLES

Prefix		Value in Terms of Unit	Abbreviation
kilo	..	1,000	k
centi	..	0·01 (10^{-2})	c
milli	..	0·001(10^{-3})	m
micro	..	0·000 001(10^{-6})	μ

(2) WEIGHTS

Denomination		Value	Abbreviation
tonne	..	1 000 kg	t
quintal	..	100 kg	q
kilogram	..	1 kg	kg
gram	..	1 g	g
milligram	..	1 mg	mg
carat	..	200 mg	c
(3) CAPACITY			
kilolitre	..	1 000 l	kl
litre	..	1 l	l
millilitre	..	1 ml	ml
(4) VOLUME			
cubic metre	..	m^3	m^3 or cu m*
cubic centimetre		cm^3	cm^3 or cu cm*
cubic millimetre		mm^3	mm^3 or cu mm*
(5) LENGTH			
kilometre	..	1 000 m	km
metre	..	1 m	m
centimetre	..	1 cm	cm
millimetre	..	1 mm	mm
micron	..	1/1 000 mm or 10^{-3} mm	μm
(6) AREA			
square kilometre		1 000 000 m^2	km^2 or sq km*
square metre	..	1 m^2	m^2 or sq m*
square centimetre		1 cm^2	cm^2 or sq cm*
square millimetre		1 mm^2	mm^2 or sq mm*
(7) LAND MEASURE			
are	..	100 m^2	a
hectare	..	100 a	ha
centiare	..	m^2	ca

*Both these abbreviations are current, but the first set should preferably be used. The former abbreviation is used more commonly internationally than the latter.

Rules for Abbreviations :

(1) Do not make any change, such as addition of 's' to indicate plurality *e.g.*, write 1 kg, 10 kg, 20 g, 5 g, 10 t, 20 ml, 27l, 165 km, 2 mm, 100 cm^3, 66 km^2;

(2) Do not capitalize the abbreviations. For example, do not write 1 Kg, 2 Kg, 20 MM, 50 MM, the right way is to write 1 kg, 2 kg, 20 mm, 50 mm, etc.;

(3) Do not use any other abbreviations except those given above.

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metric

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Development of Length and Area Measures in South India—Part 1

L. RAJU AND V. B. MAINKAR

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New Delhi

IN the earlier series of articles we have traced the possible origins and the development and resultant chaos in the weights and capacity measures used until recently in South India.[1]

We shall now consider the development of the various length and area measures in this region of India. As in the previous articles, South India is taken to mean the region covered broadly by the present States of Andhra Pradesh, Kerala, Madras and Mysore.

Length measures are now used in commerce mainly for the sale of cloth, wires, structural materials etc. or for measuring distances and like operations. In the present article we shall not consider the use of length measures for architectural and building purposes as this can form the subject matter of a separate series of articles.

Area measures, though used in transactions involving such commodities as plywood, glass, floor coverings and the like, find their most important use in the measurement of area of fields for revenue and other purposes.

The usual method of deriving the area of a field consists of measuring the lengths of its component sides and calculating the area from these lengths according to well-established geometrical formulae.

If the field is a regular geometrical figure like a triangle, square or rectangle the calculations are comparatively easy. If, however, the field has an irregular shape, the method usually employed is to divide it into discrete regular geometric figures like squares or triangles and measure the lengths of each of these figures and add up the areas of the component figures to obtain the area of the field. The length measure used for these operations may be a chain, tape, wooden pole or even a rope, usually long enough to enable the measurements to be made quickly and accurately.

In this article we shall examine only certain distinctive area measures which can be evaluated in terms of modern units.

It is because of this close relation between the length and area measures that we shall consider them together in this series of articles.

Length Measures

The various Weights and Measures Laws which were current in South India prior to the introduction of the metric system in 1958, are unanimous in adopting only the yard

and its multiples and submultiples as legal length measures. For areas, normally the squares of length measures are recognised. The units of land area are, however, rarely defined in the old Weights and Measures Acts. The only exception is that the guntha is defined as 121 square yards in the Weights and Measures Act (No. XIV of 1356 Fasli) of Hyderabad.

For the commonly used land area measures we have to look into other sources such as revenue records, gazetteers, manuals of administration, traditional tables of areas or even arithmetic textbooks.

It should be noted that in the area tables now used, the basic length unit used is usually the inch, foot or yard. There is a good reason for this situation.

The administration of any country which depends largely on revenues obtained from land would take care to enforce area units with great vigour. That is why the British, as soon as they could, after taking over a territory would have tried to standardise the land area units of the region. The basic unit, however, would be that of length. It would be natural to standardize the then existing length units in terms of units they could easily comprehend viz., the yard, the foot, the inch. Moreover, the apparently plentiful variety of length measures used for various purposes would have made it difficult for them to adopt one of them as a standard unit. The principal old unit was the hasta. This had a variable length in India (15—30 inches) but was accepted in England under the name of the cubit, as 18 inches or half a yard exactly. The obvious conclusion would, therefore, be to take, wherever possible, the equivalent of it in terms of rationalized English units. For example, as will be shown in Part 4 the rope of 158¼ feet was standardized by the British at 160 feet in Madura district. by such means, the area unit could be standardized in terms of discrete numbers of square feet, square yards or acres. This leaves open the question of what could have been the units of area used in ancient and medieval South India which were replaced by the British.

If we wish to examine this question we have to evaluate the basic length measures used by the ancients for measuring commercial lengths and for measuring areas of fields. As in the case of weights and capacity measures, we have to go back to the earliest periods of Indian history to understand the stages of development which could have led to the great variety of measures in later times.

Indus Valley Civilization

We, therefore, go back to the ancient times in India, viz., the time when the Indus Valley civilization flourished in the period 2500-1500 B.C. over a vast territory in North and Western India, measuring some 1500 km in length and equally broad. Surprisingly enough, although a large number of weights of uniform standard were found all over this vast area, only three pieces of length measures were discovered.

In Mohenjo-daro was found[2] a piece of shell on which certain lines were finely marked. There was a full circle on one mark and five marks later a hollow circle was inscribed. The line indicating each division was about 0·5 mm thick. Each division itself was 6·7 mm (0·264 inch), the distance between the five divisions being 33·528 mm. It may be assumed that the scale was divided decimally because there were 5 divisions between the full circle and the hollow circle. The next full circle would occur after another 5 divisions, giving 10 divisions between two full circles. The recurring unit, therefore, should be 67·056 mm. (2·64 in). The mean error of graduation of each division is estimated at 0·075 mm. We may then take the length of the basic recurring unit as 67 mm within limits of tolerance.

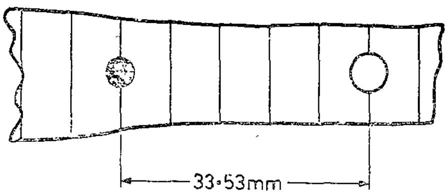

Fig. 1—The Mohenjo-daro Length Measure

In Harappa was found[3] a piece of bronze rod with 4 marks, each at an average interval of 0·934 cm.

Attempts have been made to equate these two length measures with those existing in contemporary Egypt, Babylonia, Asia Minor and elsewhere.

These pieces of length measures are the only evidence we have of the type of measures that may have been used in the Indus Valley civilization. It is difficult to deduce a system of length measures on the evidence of only two pieces. Nothing has yet been discovered to indicate in what way they were used, although it is possible to deduce that their multiples may have been used in architectural work. For example, the most popular width of doors was about 1 metre i.e. 15 times the basic unit of 67 mm, while roads of 2 metre width, equal to 30 such units, were also very common. Similarly the dimensions of the Harappan granary, the Mohanjo-daro bath etc. are sought to be explained as certain multiples of the Harappan scale.[3]

Fig. 2—The Harappa Length Measure

A third scale was found recently in Lothal.[3A] It is an ivory scale, approximately 130×6 mm. It is straight on one side and curves to a point on the other. It has 27 lines, not very evenly and accurately marked, which cover a distance of 46 mm thus giving an average distance of 1·7 mm per division. This division immediately reminds us of the Mohenjo-daro scale and 20 such divisions would be approximately equal to the distance between the two circles in the Mohenjo-daro scale (1·7×20 mm)= 33·4 mm.

In the absence of further evidence about the multiples and submultiples of the units commonly used, any conclusion on this point would only be conjectural. This prevents us from establishing the relation of these length measures with later traditions in India or even with any other contemporary traditions in the rest of the world of those days with any degree of assurance.

Vedic Times

We have, therefore, to examine the position in Vedic times which according to Dr. P. V. Kane[4] extended from 4000 B.C. to 1000 B.C. In the Vedic literature we find the earliest records of the Indian concept of weights and measures. The foundations of the units of length and area used later on are to be seen in the Veda, although the relation of one unit with another is not easily descernible.

In the Rigveda[5], the oldest Veda, references to length units like the angula, aratni, gavyuti, yojana, dashayojana (2.2.5.3; 8.1.1.9; 8.8.11.8; 8.7.1.20; 10.7.2.20; 10.8.4.7; 10.12.9.4) occur. A mention has also been made of the measurement of the area of a field (1.16.5.5). References to the yojana also occur in the Yajurveda[6] (16.54; 16.56 etc.), Taittiriya Samhita[7] (4.5.11.1.2) and the Atharvaveda[8] (6.131.3; 20.126.20). Among other units of length

mentioned are the aratni (TS 5.2.5.1; AV 19.57.6), vyama (TS 5.1.1.4; 5.1.10.5; AV 6.137.2) paurusha (TS 5.1.1.5; 5.1.10.5; 5.2.5.1.), pada (TS 6.2.4.5), and ashwina (AV 6.131.3.).

The *Vedic Index*[9] lists a number of additional units mentioned in the literature that followed the four Veda. The krosa, traipada, angustha, prakrama, pradesa, bahu, sala etc. are some examples. It is not possible to establish any coherent relation among them. The *Vedic Index*, however, notes with reference to traipada, that it is a 'measure of distance, three quarters of a yojana in the *Pancavimsa Brahmana*, where half a yojana is termed gavyuti and a quarter a krosa'.

The *Satapatha Brahmana* (12.2.1.3)[10] mentions an interesting method of measuring depths, by using the suffix *daghna* e.g. upapaksha daghna (reaching upto armpits), kanthadaghana (reaching upto the neck) urudaghna (thigh deep), janudaghna (knee-deep) etc.

Kautiliya Arthasastra

The literature in the post-Vedic period is also not very helpful in establising the relations of units. As in the case of weights and capacity measures we have to travel through centuries to the 3rd-4th century B.C. before we come across a systematic attempt to establish tables of weights and measures. The book is the inevitable Kautiliya *Arthasastra*.[11]

Being the first systematic analysis, it is intended to analyse Kautilya's table on length and area measures (*Book* 2. *Ch XX*) somewhat exhaustively; more so, as it forms, with modifications, the very foundation of later traditions in metrology.

There appear to be two editions of *Arthasastra* differing from each other in certain respects. In so far as the field of metrology is concerned besides other comparatively minor differences, one edition prescribes a goruta of 1000 dhanu, while the second one lays down that the goruta is 2000 dhanu. Sanskrit scholars have been making extensive studies to establish the correct text. Prof. Kangle has recently published an edition after considerable research and has accepted the goruta as 2000 dhanu. The goruta of 1000 dhanu is accepted by Shamasastry. Traditions have a peculiar way of establishing themselves. It is, therefore, intended to analyse both the versions of *Arthasastra* tables. It should, however, be remembered that even a wrong tradition could have taken root in some parts of India and an analysis of both the texts may be desirable for the sake of completeness of our examination.

The English translation of the portion relating to length and area measures is reproduced below from Shamasastry's book and the Sanskrit text from Kangle's edited text.

English Translation

The superintendent of lineal measure shall possess the knowledge of space and time.

8 atoms (Paramanavah) are equal to one particle thrown off by the wheel of a chariot.

8 particles	=	1 liksha.
8 likshas	=	the middle of a yuka (louse) or a yuka of medium size
8 yukas	=	1 yava (barley) of medium size.
8 yavas	=	1 angula (three fourths of an English inch). Or the middlemost joint of the middle finger of a man of medium size may be taken to be equal to an angula.
4 angulas	=	1 dhanurgraha
8 angulas	=	1 dhanurmushti
12 angulas	=	1 vitasti or 1 chhayapaurusha.
14 angulas	=	1 sama, sala, pariraya or pada.
2 vitastis	=	1 aratni or 1 prajpatya hasta.
2 vitastis plus 1 dhanurgraha	=	1 hasta used in measuring balances and cubic measures, and pasture lands.
2 vitastis plus 1 dhanurmushti	=	1 kishku or 1 kamsa

42 angulas	=	1 kishku, according to sawyers and blacksmiths, and used in measuring the grounds for the encampment of the army, for forts and palaces.
54 angulas	=	1 hasta used in measuring timber forests.
84 angulas	=	1 vyama, used in measuring ropes and the depth of digging, in terms of a man's height.
4 aratnis	=	1 danda, 1 dhanus, 1 nalika, and 1 paurusha.
108 angulas are equal to		1 garhapatya dhanus (i.e. a measure used by carpenters called grhapati). This measure is used in measuring roads and fort walls.
The same (108 angulas)	=	1 paurusha, a measure used in building sacrificial altars.
6 kamsas or 192 angulas	=	1 danda, used in measuring such lands as are gifted to Brahmanas.
10 dandas	=	1 rajju.
2 rajjus	=	1 paridesa (square measure).
3 rajjus	=	1 nivartana (square measure).
The same (3 rajjus) plus 2 dandas on one side only	=	1 bahu (arm).
1 000 dhanus	=	1 goruta (sound of a cow).
4 gorutas	=	1 yojana.

Thus are the lineal and square measures dealt with.

Original Sanskrit Text

मानाध्यक्षो देशकालमानं विद्यात् ।१।

अष्टो परमाणवो रथचक्रविप्रुट् ।२। ता अष्टौ लिक्षा ।३। ता अष्टौ यूका ।४। ता अष्टौ यवमध्य: ।५। अष्टौ यवमध्या अङ्गुलम् ।६। मध्यमस्य पुरुषस्य मध्यमाया अङ्गुल्या मध्यप्रकर्षो वाऽङ्गुलम् ।७।

चतुरङ्गुलो धनुर्ग्रहः।८। अष्टाङ्गुला धनुर्मुष्टि: ।९। द्वादशाङ्गुला वितस्ति:, छायापौरुषं च ।१०। चतुर्दशाङ्गुलं शम: शल: परिरय: पदं च ।११।

द्विवितस्तिररत्नि: प्राजापत्यो हस्त: ।१२। सधनुर्ग्रहः पौतवविवीतमानम् ।१३। सधनुर्मुष्टि: किष्कु: कंसो वा ।१४। द्विचत्वारिंशदङ्गुलस्तक्षण: क्राकचिककिष्कु: स्कन्धावारदुर्गराजपरिग्रहमानम् ।१५। चतुष्पञ्चाशदङ्गुल: कुप्यवनहस्त: ।१६।

चतुरशीत्यङ्गुलो व्यामो रज्जुमानं खातपौरुषं च।१७।

चतुररत्निर्दण्डो धनुर्नालिका पौरुषं च गार्हपत्यम्।१८।

अष्टशताङ्गुलं धनु: पथिप्राकारमानं पौरुषं चाग्निचित्यानाम् ।१९। षट्कंसो दण्डो ब्रह्मदेयातिथ्यमानम् ।२०।

दशदण्डो रज्जु: ।२१। द्विरज्जुक: परिदेश: ।२२। त्रिरज्जुकं निवर्तनम् एकत: ।२३। द्विदण्डाधिको बाहु: ।२४।

द्विधनु:सहस्रं गोरुतम् ।२५। चतुर्गोरुतं योजनम् २६। इति देशमानम् ।२७।

(*Arthasastra 2.20*)

Examination of Table

While analysing this table we shall neglect the very small units from paramanu upto yava as these could not have been used for commercial purposes and we may treat them more as notional than real. The yava is important as it defines the angula, the fundamental unit of Kautilya's table. It has some significance in understanding later conventions.

The yava is defined here as of 'middle size'. Prof. Kangle[12] is of the opinion that *yavamadhya* is 'the middle of the barley grain' i.e. its width at the maximum, rather than 'middle-sized barley grain'. For the latter, we should have had *madhyamayava*. The explanation appears to be logical and should be accepted. It would, however, be shown later on that the dimension of the yava as mentioned in *Arthasastra* is different from that accepted later on, although the word has remained unchanged.

We may now examine the table taking the angula as the fundamental unit. It should be mentioned here that the angula at this time was probably related with the human finger as defined by Kautilya. We have established this fact in Part 1 of the article on capacity measures.[1] In the same article,

we have also evaluated the hasta (28 angula). and aratni (24 angula) from available evidence of the traditions of metrology in India and the dimensions prescribed for cubic measures. We arrived at the following results :

Angula = 17·86 mm
Prajapatya hasta = 42·86 cm (24 angula)
Commercial hasta = 50 cm (28 angula)

The Hasta Measures

An examination of the *Arthasastra* table shows that at least 3 hasta measures, viz. 24, 28 and 54 angula have been prescribed for different uses. It is, however, rather strange that the hasta (28 angula) used for administrative and commercial purposes should work out to 50 cm or half a metre. Why did the ancients not use the Prajapatya hasta of 24 angula which could be more easily defined, being the length from the elbow to the end of the middle finger ? Why was it necessary to use another hasta, 4 angula longer, for commercial and administrative or practical measurements ?

The very fact that the commercial hasta is ½ metre would immediately lead us to believe that it was perhaps derived on the basis of the same principles as were used in defining the metre originally. The metre at its birth was taken as the ten millionth part of the quadrant of the meridian of the earth passing through Dunkirk and Barcelona.

Could such a derivation have been possible in those distant days ? It is now well-known that the science of astronomy was fairly well advanced in the ancient times in many countries like Egypt, Babylonia and India. In fact, there have been many convincing arguments put forth to establish that the Egyptian cubit was related with the circumference of the earth[13]. Even the Babylonian cubit is taken to be based on the dimensions of the earth.[14] It is fascinating to believe that the ancient Indians may also have calculated fairly accurately the circumference of the earth and subdivided it until they arrived at a fraction, in this case eighty millionth part, which gave them a unit which could be easily handled. The unit happened to be 4 angula longer than the traditional hasta of 24 angula.

Other theories that could be advanced to explain the hasta of 28 angula are that it was derived on the basis of some geometrical relationship which is not clear to us now, or that it was just a sheer accident that the hasta had a value of ½ metre, there being no geodetic or geometric origin for it. The correct explanation, however, eludes us at the moment.

There are differences of opinion among scholars as to whether the 50 cm commercial hasta had an Indian origin. Some scholars are unwilling to attribute originality to the Indian mind and would strongly maintain that the hasta was imported from Egypt, Babylonia, Assyria or some other place. It is maintained by some that the Indian commercial hasta of 50 cm was based on Gudea's rule, (2175 BC[13,15]). Gudea's rule was divided into 30 parts and had a length of 50·29 cm (19·8 in) each division thus being 16·7 mm. (*See* also Part 4 for 50·3 cm hasta used in India, under *Godavari District*).

There are others who do not subscribe to this view.

We need not enter into the controversy. For our purpose, what matters is that whatever its origin, Indian or foreign, terrestrial or geometric, the 50 cm hasta occupies an extremely important place throughout the long history of commercial metrology in India.

Seeds of Multiplicity

As we have already seen, the *Arthasastra* table lays down three different hasta measures

(24, 28 and 54 angula). It also prescribes two kishku (32 and 42 angula), 2 danda (96 and 192 angula), 2 dhanu (96 and 108 angula) and 2 paurusha (96 and 108 angula). There are also 2 goruta (1000 dhanu according to Shamshastry and 2 000 dhanu according to Prof. Kangle) and as a result of two dhanu measures and 2 goruta, 4 yojana measures could be derived, as shown later. This multiplicity of length units also leads to two values for the nivartana and paridesa and 4 for the bahu.

The seeds of later confusion of interpretation of the length and area units can be distinctly seen in the *Arthasastra.*

We may now attempt an explanation to clarify certain concepts and traditions.

The first important point that can be noted from the use of pattern laid down by Kautilya, is that the units related with 28 angula hasta are generally used for measurements of a commercial or practical nature or what may be called *vyavaharik* measurements. Thus subunits and multiples like 14, 28, 42, 84 angula are used for measurements connected with ropes for area measures, palaces, forests, depth of digging, capacity measures, balances, areas of pasture lands etc.

The second series of units connected with the 24 angula hasta like paurusha (4 aratni and 108 angula) appear to be used more often for religious purposes than commercial.

The third section consists of units which are not directly related with the 24 or 28 angula hasta viz. kamsa (32 angula), or kishku (54 angula), the garhapatya dhanus or paurusha of 108 angula. The paurusha and the 28 angula hasta have an important place in the area measures used in South India.

A fourth section relates to units indicating long distances.

The fifth covers area measures.

In Table 1 are presented the values of the principal useful *Arthasastra* units. Both metric and inch values are given for ease of reference. Calculations are, however, based on metric values only.

Do you Know

Time can now be measured to an accuracy of one second in 3000 years. This has been made possible by the advances in atomic sciences. The cesium atomic makes possible this astonishing precision measurement of time. Such accuracy is now necessary as we are in the age of sputniks and satellites hurtling around the earth at speeds of over eight kilometres per second. It has bean estimated that an error of 1/10 of a second in the measurement of time may mean that the tracking of the orbiting satellite may be out by one kilometre.

TABLE 1—ARTHASASTRA TABLE ANALYSED

Basis : Angula = $\left(\frac{500}{28}\right)$ mm = 17·8571 mm

Sl. No.	Name of Unit	Angula	Dimension: Metric Units	Dimension: Inch Units
		Group 1		
(1)	Sama Sala Pariraya Pada	14	25 cm	9·84 in.
(2)	*Hasta (I)	(21)	(37·5 cm)	14·76 in.
(3)	Hasta, commercial (II)	28	50 cm	19·685 in.
(4)	Kishku (I)	42	75 cm	29·53 in.
(5)	Vyama	84	1·5 m	59·06 in.
		Group 2		
(6)	Vitasti, Chhayapaurusha	12	21·43 cm	8·44 in.
(7)	Aratni, Prajapatya hasta (III)	24	42·86 cm	16·87 in.
(8)	*(Double aratni)	(48)	85·71 cm	33·74 in.
(9)	Danda (I) Dhanu (I) Nalika, Paurusha (I)	96	1·7143 m	5·62 ft.
(10)	Paurusha (II)	108	1·9286 m	6·33 ft.
(11)	Danda (II)	192	3·4286 m	11·25 ft.
		Group 3		
(12)	Kishku (II), kamsa	32	57·14 cm	22·50 in.
(13)	Hasta (IV)	54	96·43 cm	37·96 in.
(14)	Garhapatya Dhanu (II)	108	1·9286 m	6·33 ft.
		Group 4		
(15)	Rajju	960(I)	17·1429 m	56·24 ft.
	(10 danda)	1920 (II)	34·2857 m	112·49 ft.
(16)	Goruta	96 X 1000(I)	1·7143 km	1·07 miles
	(1000 dhanu)	108 X 1000 (II)	1·9286 km	1·20 miles
	(2000 dhanu)	96 X 2000(I)	3·4286 km	2·13 miles
		108 X 2000(II)	3·8571 km	2·40 miles
(17)	Yojana	4 goruta	6·8571 km	4·26 miles
			7·7143 km	4·79 miles
			13·7143 km	8·52 miles
			15·4286 km	9·59 miles
		Group 5		
(18)	Paridesa	2 rajju (2R)		
		$(34{\cdot}2857 m)^2$	1175·7 m^2	1406·1 yd^2
		$(68{\cdot}5714\ m)^2$	4702·7 m^2	5624·3 yd^2
(19)	Nivartana	3 rajju (3R)		
		$(51{\cdot}4286\ m)^2$	2645·3 m^2	3163·7 yd^2
		$(102{\cdot}8574\ m)^2$	10581·0 m^2	12654·8 yd^2
		3 rajju + 2 danda & 3 rajju		
(20)	Bahu	(3 R+2d) (3 R)		
		(54·8571m) (51·4286m)	2821·2 m^2	3374·2 yd^2
		(58·2858m)(51·4286m)	2997·6 m^2	3585·1 yd^2
		(105·2857m)(102·8571m)	10829·4 m^2	12952·0 yd^2
		(109·7143m)(102·8571m)	11284·9 m^2	13496·7 yd^2

These are estimated here because there will be occasions to refer to them in Part 2.

Some Observations

It is necessary to make a few observations on the multiplicity of values obtained for the length and area measures in Groups 4 and 5 in Table 1. The rajju is 10 danda. There are two types of danda, one being twice the other. The larger danda of 192 angula is to be used for measuring lands gifted to Brahmanas. There is no specific instruction as to which of the two danda should be utilized for evaluating the rajju for measuring other lands. We have used both the danda to enable us to examine traditions that developed later on. In fact, we shall show in Part 2 that both types of rajju have been used in later times to define area measures. Of the three area units, the nivartana and paridesa became rather popular in later times. The *Arthasastra* also lays down that the 28 angula hasta, 42 angula kishku, and 54 angula hasta should also be used for measuring areas for specialized purposes. We shall treat the area units based on these length measures in Part 2.

The units of goruta and consequently the yojana, which is just 4 times goruta, acquire four values. The reason is that there are two dhanu (96 angula and 108 angula) which we have taken as the basic units for defining the goruta. Furthermore, there are two opinions about the number of dhanu in a goruta. According to one reading, as quoted by Shamasastry it is 1000 dhanu, while according to the second reading, as quoted by Prof. Kangle, it is 2000 dhanu.

It is a little difficult to select a single value from these four as indicative of the *Arthasastra* tradition. We have, therefore, quoted the 4 values of goruta and yojana for comparative purposes. It would, however, be desirable to take the values based on the dhanu of 108 angula as correct because it is specifically mentioned by Kautilya that this particular dhanu was used for measuring roads.

We should also note the tradition recorded in the *Tandyamaha Brahmana*[16] where half of yojana is called gavyuti and a quarter is krosa. Both these terms do not occur in the *Arthasastra*, though krosa is commonly used in later literature. The krosa could be equated with the goruta and the gavyuti with 2 krosa, provided the two yojanas are equal.

We have also derived the values for additional units of 21 and 48 angula, as reference is made to them in Part 2 while examining the transformation of the *Arthasastra* units. It should be observed here that the ratio of commercial hasta (28 angula) to the double aratni (48 angula) is as 7 : 12. This relation will be used in Part 2 to analyse certain traditions.

In Part 2 we shall examine how the metrological traditions given in the *Arthasastra* underwent changes which resulted in lending the later records an appearance of a new set of values unrelated with the *Arthasastra*. We shall show that although there was a change, it did not alter substantially the fundamentals recorded in the *Arthasastra*.

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Arithmetic & Abbreviations

Textbooks for arithmetic are now being revised to use metric units predominently. It of foot-pound and seer units is rather restricted. It has, however; been noticed that certain standard books on arithmetic have been using the wrong abbreviations like 'kilog' for kilogram , 'Dm' for decametre and so on. These abbreviations have now been internationally rejected and textbook writers and publishers should take note of the abbreviations published on cover page 2 of this issue as also those which have been laid down by the Eleventh General Conference of Weights and Measures in 1960. The latter were published in the September 1961 issue of **Metric Measures** on pages 23 and 24.

Let the new generation be taught the correct usages of the metric system.

*Introduction of Decimal Coinage in India**

INDIA switched over to the decimal system of coinage on 1 April 1957 when new decimal coins of the denominations of 10 nP, 5nP, 2 nP and 1 nP were issued all over the country. Under this system the rupee remains the monetary unit of the country but it is divided into 100 equal parts, each part being termed a 'naya paisa'. The system envisaged the issue, in addition, of coins in the denominations of a rupee, 50 nP, and 25 nP but as these denominations were exactly equivalent to the rupee, the half rupee and the quarter rupee coins of the anna-pie series their issue was deferred till such time as the Mints were able to produce and accumulate enough stocks of coins in the lower denominations. All the coins of the series have since been issued in gradual stages; the 25 nP was put into circulation from 1 December 1959, the 50 nP from 1 November 1960 and the decimal rupee coins from 2 July 1962.

Background

The question of decimal coinage and the manner in which it should be introduced had been before the Govenrment and the public for over ten years before it was actually introduced. As far back as 1945, the undivided Government of India had sought to elicit public opinion in the matter through various bodies like the State Governments, Chambers of Commerce, scheduled banks etc. The views received were on the whole favourable to the introduction of the reform and in February 1946, a Bill was introduced in the Legislative Assembly to convert the anna-pie coinage into decimal coinage, retaining the rupee as the standard unit and dividing it into 100 cents. The Bill was circulated for public opinion in April 1946, and in February 1947, the Government of India had decided to proceed with the Bill. But partition of the country, with its consequential unsettlement, intervened and the matter was allowed to lapse. In 1949, the Indian Standards Institution set up a Special Committee to make recommendations on the introduction of the metric system of weights and measures in India. The Committee after extensive consultations with practically all interests concerned, recommended that it would be an advantage if the adoption of decimal currency preceded the introduction of the metric system of weights and measures. In April 1955, the Planning Commission made the same recommendation that, as a first step towards the adoption of the metric system, a Bill should be introduced in Parliament providing for the decimalisation of coinage. A Bill amending the Indian Coinage Act, 1906, was introduced and passed by the Parliament in 1955.

The change-over to decimal coinage has been on the whole very smooth and well received by the public at large. However, this has not been without complaints which was expected. Some sections of the people have been inconvenienced but almost invariably in a small way. There has never been any nation-wide reform in any country without inconvenience or annoyance to some people. A pertinent question here

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would be if people were cautioned well in advance. A wide publicity and wider propaganda through leaflets and brochures, newspaper articles and advertisements, films and radio talks, had been undertaken months in advance and continued even after the introduction of the reform to instruct the people about what the reform meant and how it would affect the individual. It has been stated time and again that there would be petty annoyances to the individual for a short while, but this had to be viewed against the large and permanent gains which the country would make from the reform.

Educating the Public

The fact that the reform had a smooth passage is an indication of the amount of thinking done and preparatory steps taken by the authorities concerned prior to the introduction of the reform, so as to overcome any conceivable difficulty that might be encountered particularly in the field of banking, accountancy, etc. In a country of of the size of India where the people with low level of literacy were accustomed through generations to the anna-pie system, the reform had to be preceded by publicity and propaganda on a very extensive scale. In addition, the incorporation in textbooks of lessons in the new coinage to suit the different grades of pupils in schools was also arranged. A Handbook on decimal coinage for distribution among teachers was also prepared. Innumerable sets of new coins mounted on card-boards were distributed to the State Governments, Community Development Blocks, etc. for purposes of demonstration. Copies of conversion tables indicating the values of anna-pie coins converted in terms of decimal coins in accordance with the provisions of the Indian Coinage (Amendment) Act, 1955, with suitable instructions were printed and supplied free to various organisations all over the country. As a result of these measures the change-over went through smoothly.

Early Steps

Besides the question of educating the public about the need and advantages of the reform, there were certain other problems which had to be tackled before the reform could be introduced. Arrangements had to be made to provide facilities to the public all over the country to exchange their holdings of anna-pie coins into decimal coins through the offices of the Reserve Bank of India and the State Bank and its agency banks, all Government Treasuries and Sub-treasuries, etc. The manufacture of coins of the anna-pie series had to be stopped and the Mints switched on to the production of the new decimal coins a long time in advance of the introduction of the reform and the working hours of the Mints also had to be increased to enable them to stockpile the coins required to be distributed among all these coin issuing offices. Although both the anna-pie and the decimal coins were to be in circulation simultaneously for some time, it was found necessary that the decimalised system of coinage should be officially adopted with effect from the date of introduction of the reform as the sole medium of accounting by Government departments, semi-government organisations and other public institutions, banks, commercial houses etc. Revised procedures and forms had to be devised in consultation with the Reserve Bank of India and the Comptroller and Auditor General and suitable instructions were issued to all concerned.

Railways, Posts & Telegraphs

The Railways had to undertake a heavy programme of preparatory work, in refixing rates and fares in terms of the new coinage and reprint their calculation tables for distribution throughout the country. The Indian Post Office Act was amended to enable the refixation of postal rates in terms of

decimal coinage and new stamps etc. were issued. As there were considerable stocks of postage stamps, post cards, envelopes, etc. of the old series, the destruction of which would have involved Government in a considerable loss, it was necessary to continue to sell and accept these items of postal stationery even after the introduction of the reform but after equating the value of the various denominations of stamps and other stationery in the old series to the corresponding denominations in the new series by means of Gazette notification under the powers conferred by the Indian Post Office Act. Non-postal stamps of over 300 varieties and denominations such as revenue stamps, entertainment tax stamps, copying fee stamps, etc. issued by the Central and State Governments had to be reissued in terms of decimal values, in consultation with the State Governments concerned. Adding —, accounting—, calculating—machines in use in the various Government and non-government offices had to be converted to the decimal system. Discussions were held with the concerned Ministries and suppliers of the machines, an inventory of the machines in use in the country was made and facilities were afforded to the suppliers to import spare parts necessary to convert existing machines, to re-export unsold surplus machines and to import new machines suited to the decimal system. All these and allied problems had to be tackled in consultation with the various authorities and suppliers concerned and with patience and precision. Thanks to the general enthusiasm for the coinage reform, all these matters were satisfactorily settled although not always in time. For instance Postal franking machines suited to indicate the postal rates in anna-pie coins had to be used till the very day of the introduction of the reform and their conversion to decimal coinage to a large extent could be undertaken only after the reform was actually introduced. Pending such conversion they had to be continued in use and any additional postage required made up by affixing stamps. Except for a few items like the one mentioned above, all administrative arrangements were completed well in time, and there had been hardly any bottlenecks in the smooth progress of the reform from the date of its introduction.

Withdrawal of Old Coins

The issue of the coins of all denominations in the decimal series does not by itself complete the reform. A reform of this type can be said to have been completed only when all the coins of the earlier series have been demonetised and withdrawn from circulation. At the time of the introduction of the reform it was envisaged that coins of both the anna-pie and decimal series would circulate simultaneously for about three years by which time, the coins in the anna-pie series would be withdrawn from circulation in a phased programme of demonetisation. The first step towards the withdrawal of anna-pie coins was taken in 1958 when the nickel-brass two anna, the half pice and the pie coins were demonetised with effect from 1 January 1959. This was followed by the demonetisation of the nickel brass one-anna and the nickel-brass half anna coins from 1 January 1960 and of the cupro-nickel two anna and the cupro-nickel half anna from 1 October 1960. Thereafter, due to the development of the economy of the country, there was a phenomenal increase in the demands for small coins and the Mints had been hard put to meet the rising demands for coins. Consequently it was not possible to launch the demonetisation of the cupro-nickel one anna and the copper and bronze pice coins which continued to be legal tender. In order to enable the Mints to increase their production and to accumulate enough stock of decimal coins to facilitate the demonetisation of these coins, the working hours of the Mints were

increased from April 1961. Now, it would be possible to demonetise these coins from 1-1-64. With this, all the coins in the anna-pie series which did not have exact equivalents in the decimal series would have been demomenetised, and to that extent the reform may be stated to have been completed.

It is only apt and proper that India should switch over to decimal coinage, as she has a very close association with the decimal system from the historical point of view. In the whole history of mathematics there has not been a more revolutionary discovery than the one which the ancient Indians made when they invented the sign 'Zero' to stand for the empty columns of the counting frame. The Greeks, in spite of their advance in other fields like geometry, had failed to develop algebra and it was only the Indians and the Arabs who succeeded in this important branch of the science of measurement and calculation which is the corner stone of modern mathematics. The inventors of the 'shunya' or the 'zero' had liberated the human intellect from the confines of the counting frame. As the brilliant mathematical astronomer Laplace (1749-1827) has stated :

> It is India that gave us the ingenious method of expressing all numbers by means of ten symbols, each symbol receiving a value of position as well as an absolute value; a profound and important idea which appears so simple to us now that we ignore its merits, but its very simplicity, the great ease which it has lent to all computations, puts our arithmetic in the first rank of useful inventions; and we shall appreciate the grandeur of this achievement when we remember that it escaped the genius of Archimedes and Appolonius, two of the greatest men produced by antiquity.

Permissible Error in Biscuit Packets

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While purchasing a packet of biscuits you might have noticed the net content marked on the wrapper. An average customer has to be satisfied with this as he has no means to verify whether the packet actually contains the declared quantity.

This is, of course, not peculiar to biscuits alone, but holds good for almost every commodity we purchase in a sealed cover. If we wish to safeguard the interest of the consumers, mere marking of the contents on the body would not be enough. The marked weight or measure must be verified by an independent agency. Weights and Measures (Enforcement) Rules trade by State Governments, therefore, invest the Inspector of Weights and Measures with full authority to check the net contents of all sealed packages offered for sale. If the actual net content is found to be deficient, the seller is liable to prosecution.

It need not be emphasized that the marked net contents cannot be exactly equal to the actual contents due to various factors. If the commodity in question is highly hygroscopic like tea it may, while in storage and transit, gain or lose weight to the tune of 8 percent. Tea packed in Calcutta would lose considerable weight by the time it is offered for sale in Rajasthan after 2 or 3 months.

Factors Causing Variation

Biscuits have peculiarities of their own. In the first place, biscuits are manufactured in pre-determined sizes. The manufacturer does not have complete control over the thickness of the biscuit due to variation in atmospheric condition as well as in the quality of the raw materials used. Packet sizes are also pre-determined. A packet of biscuits must contain a whole number of biscuits. We cannot put half or quarter biscuit in a packet. Now suppose that a certain packet is designed to contain 10 biscuits. If for any reason the thickness of the biscuit is more than the normal the packet will contain only 9 biscuits. Similarly, if the biscuits are slightly thinner the packet may hold 11 biscuits. In a small pack, therefore, this factor alone will introduce a variation of the order of 10 percent of the marked weight.

Materials used for packing may also cause variation in the weight of the final package. The usual procedure is that packets are weighed only after they are filled with biscuits and are ready for the market. If, therefore, the weight of packing material is excessive, the net weight of biscuits will be short. Tin containers themselves vary considerably in weight. The same applies to cartons and other stuffing materials. In certain cases packing materials account for 67 percent of the gross weight of a pack.

It is necessary, therefore, to allow for reasonable variations in the net weights of biscuits in packages.

Investigation Undertaken

With a view to study the variations that normally occur in the net weights of biscuits in packages, an investigation was undertaken in the factory of the *Britannia Biscuit Co. Ltd.* Calcutta. This factory was selected in view of its being highly mechanised and where the processes of manufacture and packing are under strict control. Full facilities were extended by the Company for which the Directorate of Weights and Measures is grateful.

Britannia manufactures many brands of biscuits. As it was not possible to extend the scope of the study to all brands it was limited only to the more popular varieties, *viz.*, (1) Circus, (2) Cream Cracker, (3) Thin Arrowroot, (4) Cottage Cream and (5) Glaxo. In Cream Cracker and Thin Arrowroot three different sizes of packages were studied, in Cottage Cream two and one each for Circus and Glaxo. A sample of packages was drawn randomly for each variety and size. The selection was made from the store of the Company with the help of random sample numbers.

Once the packets were taken out, they were transferred to the laboratory of the Company for detailed study. The gross weight, the net weight of biscuits and the weight of packing material used were estimated for each package. The following table gives the actual net weights of the biscuits in the packages sampled.

TABLE 1—RESULTS OF INVESTIGATION)

Sample No.	Variety	Weight marked on the packs	Mean net weight of the sample	s=Estimate of population S.D: $\frac{(X-W)^2}{n-1}$	3s	$\frac{3s \times 100}{W}$	Max. Positive error noticed in in the packs		Max. negative error noticed in the packs	
							Magnitude:	Percentage	Magnitude:	percentage
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8A)	(8B)	(9A)	(9B)
(1)	Circus	4·50 kg	4·505 kg	0·065 kg	0·195 kg	4·3	0·115 kg	2·5	0·075 kg	1·7
(2)	Creamr Cacker	4·50 kg	4·542 kg	0·059 kg	0·177 kg	3·9	0·098 kg	2·2	nil	nil
(3)	Cream Cracker	225 g	217·3 g	14·0 g	42·0 g	18·7	8 g	3·5	22 g	9·8
(4)	Cream Cracker	640 g	645·7 g	24·96 g	74·9 g	11·7	36 g	5·6	28 g	4·4
(5)	Thin Arrowroot	5·25 kg	5·236 kg	0·041 kg	0·123 kg	2·3	0·020 kg	0·4	0·085 kg	1·6
(6)	Thin Arrowroot	225 g	229·0 g	7·1 g	21·3 g	9·5	11 g	4·9	2 g	0·9
(7)	Thin Arrowroot	650 g	627·5 g	33·6 g	100·8 g	15·3	12 g	1·8	55 g	8·5
(8)	Cottage Cream	230 g	220·8 g	12·09 g	36·3 g	15·8	1 g	0·4	18 g	7·8
(9)	Cottage Cream	900 g	874·2 g	33·06 g	99·2 g	11·0	4 g	0·4	40 g	4·4
(10)	Glaxo ..	810 g	819·7 g	40·80 g	122·4 g	15·1	48 g	5·9	55 g	6·8

S.D.=Standard deviation

Figures in Col. 6 of Table 1 give the maximum variation on either side of the marked net weight that is likely to occur in packages manufactured and packed in the conditions prevailing in *Brittannia Biscuit Co.*

Conclusion

On this basis, we may conclude that the following margin of error has to be tolerated in biscuit packs offered for sale :

Net Weights of Package	*Limits of Error*
(1) Below 500 g	±7 percent
(2) 500 g and above but less than 1 kg	±6 percent
(3) 1 kg and above but less than 2 kg	±5 percent
(4) 2 kg and above	±2·5 percent

For Defence

Strength

For Strength

Planned

Development

Volume of One Metre Logs

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With the adoption of the metric system in transactions in timber and timber products from 1 October 1962, the existing volume tables for timber have become obsolete and a new volume table for timber giving at least the volume of log timber for girths ranging from 20 cm to 400 cm and length from 0.05 metre to 15.00 metres has become absolutely necessary to meet the requirements of the timber merchants, Forest Departments and Public Works Departments. The volume of log timber for one metre length and girth ranging from 20 cm to 400 cm with an interval of 1 cm is presented here in a table.

In order to arrive at the volume of log timber of any length having a given girth one has to multiply the volume for 1 metre length of timber of that girth by the length and put the decimal point in the correct place.

How to Use the Tables

If one wants the volume of a log of 12.5 m length and girth 15 cm, multiply the figure given in the column 'Volume for 1 metre length' against 175 cm girth by 12.5 *i.e.*

$$0.19140625 \times 12.5$$

$=2.392578125$ or 2.3926 m^3, correct to 4 decimal places.

TABLE 1. LOGS OF VOLUME OF ONE METRE LENGTH FOR VARIOUS GIRTH

Mid Girth (cm)	Volume (m^3)	Mid Girth (cm)	Volume (m^3)
20	0·0025	55	0·01890625
21	0·00275625	56	0·0196
22	0·003025	57	0·02030625
23	0·00330625	58	0·021025
24	0·0036	59	0·02175625
25	0·00390625	60	0·0225
26	0·004225	61	0·02325625
27	0·00455625	62	0·024025
28	0·0049	63	0·02480625
29	0·00525625	64	0·0256
30	0·005625	65	0·02640625
31	0·00600625	66	0·027225
32	0·0064	67	0·02805625
33	0·00680625	68	0·0289
34	0·007225	69	0·02975625
35	0·00765625	70	0·030625
36	0·0081	71	0·03150625
37	0·00855625	72	0·0324
38	0·009025	73	0·03330625
39	0·00950625	74	0·034225
40	0·0100	75	0·03515625
41	0·01050625	76	0·0361
42	0·011025	77	0·03705625
43	0·01155625	78	0·038025
44	0·0121	79	0·03900625
45	0·01265625	80	0·0400
46	0·013225	81	0·04100625
47	0·01380625	82	0·042025
48	0·0144	83	0·04305625
49	0·01500625	84	0·0441
50	0·015625	85	0·04515625
51	0·01625625	86	0·046225
52	0·0169	87	0·04730625
53	0·01755625	88	0·0484
54	0·018225	89	0·04950625

Mid Girth (cm)	Volume (m³)
90	0·050625
91	0·05175625
92	0·0529
93	0·05405625
94	0·055225
95	0·05640625
96	0·0576
97	0·05880625
98	0·060025
99	0·06125625
100	0·0625
101	0·06375625
102	0·065025
103	0·06630625
104	0·0676
105	0·06890625
106	0·070225
107	0·07155625
108	0·0729
109	0·07425625
110	0·075625
111	0·07700625
112	0·0784
113	0·07980625
114	0·081225
115	0·08265625
116	0·0841
117	0·08555625
118	0·087025
119	0·08850625
120	0·0900
121	0·09150625
122	0·093025
123	0·09455625
124	0·0961
125	0·09765625
126	0·099225
127	0·10080625
128	0·1024
129	0·10400625
130	0·105625
131	0·10725625
132	0·1089
133	0·11055625
134	0·112225
135	0·11390625
136	0·01156
137	0·11730625
138	0·119025
139	0·12075625
140	0·1225
141	0·12425625
142	0·126025
143	0·12780625
144	0·1296
145	0·13140265
146	0·133225
147	0·13505625
148	0·1369
149	0·13875625
150	0·140625
151	0·14250625
152	0·1444
153	0·14630625
154	0·148225
155	0·15015625
156	0·1521
157	0·15405625
158	0·156025
159	0·15800625
160	0·1600
161	0·16200625
162	0·164025
163	0·16605625
164	0·1681
165	0·17015625
166	0·172225
167	0·17430625
168	0·1764
169	0·17850625
170	0·180625
171	0·18275625
172	0·1849
173	0·18705625
174	0·189225
175	0·19140625
176	0·1936
177	0·19580625
178	0·198025
179	0·20025625
180	0·2025
181	0·20475625
182	0·207025
183	0·20930625
184	0·2116
185	0·21390625
186	0·216225
187	0·21855625
188	0·2209
189	0·22323625
190	0·225625
191	0·22800625
192	0·2304
193	0·23280625
194	0·235225
195	0·23765625
196	0·2401
197	0·24255625
198	0·245025
199	0·24750625
200	0·2500
201	0·25250625
202	0·255025
203	0·25755625
204	0·2601
205	0·26265625
206	0·265225
207	0·26780625
208	0·2704
209	0·27300625
210	0·275625
211	0·27825625
212	0·2809
213	0·28355625
214	0·286225
215	0·28890625
216	0·2916
217	0·29430625
218	0·297025
219	0·29975625
220	0·3025
221	0·30525625
222	0·308025
223	0·31080625
224	0·3136
225	0·31640625
226	0·319225
227	0·32205625
228	0·3249
229	0·32775625
230	0·330625
231	0·33350625
232	0·3364
233	0·33930625
234	0·342225
235	0·34515625
236	0·3481
237	0·35105625
238	0·354025
239	0·35700625
240	0·3600
241	0·36300625
242	0·366025
243	0·36905625
244	0·3721
245	0·37515625

Mid Girth (cm)	Volume (m³)
246	0·378225
247	0·38130625
248	0·3844
249	0·38750625
250	0·390625
251	0·39375625
252	0·3969
253	0·40005625
254	0·403225
255	0·40640625
256	0·4096
257	0·41280625
258	0·416025
259	0·41925625
260	0·4225
261	0·42575625
262	0·429025
263	0·43230625
264	0·4356
265	0·43890625
266	0·442225
267	0·4455625
268	0·4489
269	0·45225625
270	0·455625
271	0·45900625
272	0·4624
273	0·46580625
274	0·469225
275	0·47265625
276	0·4761
277	0·47955625
278	0·483025
279	0·48650625
280	0·4900
281	0·49350625
282	0·497025
283	0·50055625
284	0·5041
285	0·50765625
286	0·511225
287	0·51480625
288	0·5184
289	0·52200625
290	0·525625
291	0·52925625
292	0·5329
293	0·53655625
294	0·540225
295	0·54390625
296	0·5476
297	0·55130625
298	0·555025
299	0·55875625
300	0·5625
301	0·56625625
302	0·570025
303	0·57380625
304	0·5776
305	0·58140625
306	0·585225
307	0·58905625
308	0·5929
309	0·59675625
310	0·600625
311	0·60450625
312	0·6084
313	0·61230625
314	0·616225
315	0·62015625
316	0·6241
317	0·62805625
318	0·632025
319	0·63600625
320	0·6400
321	0·64400625
322	0·648025
323	0·65205625
324	0·6561
325	0·66015625
326	0·664225
327	0·66830625
328	0·6724
329	0·67650625
330	0·680625
331	0·68475625
332	0·6889
333	0·69305625
334	0·697225
335	0·70140625
336	0·7056
337	0·70980625
338	0·714025
339	0·71825625
340	0·7225
341	0·72675625
342	0·731025
343	0·73530625
344	0·7396
345	0·74390625
346	0·748225
347	0·75255625
348	0·7569
349	0·76125625
350	0·765625
351	0·77000625
352	0·7744
353	0·77880625
354	0·783225
355	0·78765625
356	0·7921
357	0·79655625
358	0·801025
359	0·80550625
360	0·8100
361	0·81450625
362	0·819025
363	0·82355625
364	0·8281
365	0·832655625
366	0·837225
367	0·84180625
368	0·8464
369	0·85100625
370	0·855625
371	0·86025625
372	0·8649
373	0·86955625
374	0·874225
375	0·87890625
376	0·8836
377	0·88830625
378	0·893025
379	0·89775625
380	0·9025
381	0·90725625
382	0·912025
383	0·91680625
384	0·9216
385	0·92640625
386	0·931225
387	0·93605625
388	0·9409
389	0·9457625
390	0·950625
391	0·95550625
392	0·9604
393	0·96530625
394	0·970225
395	0·97515625
396	0·9801
397	0·98505625
398	0·990025
399	0·99500625
400	1·0000

Recent Notifications

(1) Standards of Weights & Measures (Amendment) Rules, 1963

S.O. No. 2962 dated 7th October 1963.

In exercise of the powers conferred by Section 17 of the Standards of Weights & Measures Act, 1956 (89 of 1956), the Central Government hereby makes the following rules to amend the Standards of Weights and Measures Rules, 1958, namely :—

1. These rules may be called the Standards of Weights & Measures (Amendment) Rules, 1963.

2. In the Standards of Weights and Measures Rules, 1958,—

(*i*) To sub-rule (1) of rule 4, the following proviso shall be added, namely :— 'Provided that in the case of length measures made of fifty-eight per cent nickel steel, such interval shall not be more than ten years.'

(*ii*) for the Second Schedule, the following Schedule shall be substituted, namely 'The Second Schedule

(*See* rule 5)

COMMERCIAL WEIGHTS AND MEASURES

1. Weights

Type of Weights	Denomination of Commercial weights	Limits of error which may be tolerated at the time of verification and stamping	Limits of error which may be tolerated at the time of Inspection for other purposes
1	2	3	4
		mg	mg
Cast Iron and Steel Weights	50 kg	+20,000	—10,000 to +20,000
	20 kg	+10,000	—5,000 to +10,000
	10 kg	+5,000	—2,500 to +5,000
	5 kg	+3,000	—1,500 to +3,000
	2 kg	+1,600	—800 to +1,600
	1 kg	+1,000	—500 to +1,000
	500 g	+600	—300 to +600
	200 g	+400	—200 to +400
	100 g	+320	—160 to +320
	50 g	+200	—100 to +200
Other Weights Except Bullion and Carat Weights	1 kg	+250	—125 to +250
	500 g	+150	—75 to +150
	200 g	+100	—50 to +100
	100 g	+80	—40 to +80
	50 g	+60	—30 to +60
	20 g	+50	—25 to +50
	10 g	+40	—20 to +40

1	2	3	4
		mg	mg
	5 g	+30	−15 to +30
	2 g	+20	−10 to +20
	1 g	+10	−5 to +10
	500 mg	+8·0	−4·0 to +8·0
	200 mg	+6·0	−3·0 to +6·0
	100 mg	+4·0	−2·0 to +4·0
	50 mg	+2·0	−1·0 to +2·0
	20 mg	+2·0	−1·0 to +2·0
	10 mg	+1·0	−0·5 to +1·0
	5 mg	+0·4	−0·2 to +0·4
	2 mg	+0·2	−0·1 to +0·2
	1 mg	+0·1	−0·05 to +0·1
Bullion Weights	20 kg	+500	−250 to +500
	10 kg	+250	−125 to +250
	5 kg	+150	−75 to +150
	2 kg	+80	−40 to +80
	1 kg	+50	−25 to +50
	500 g	+30	−15 to +30
	200 g	+20	−10 to +20
	100 g	+16	−8 to +16
	50 g	+12	−6 to +12
	20 g	+10	−5 to +10
	10 g	+8	−4 to +8
	5 g	+6	−3 to +6
	2 g	+4	−2 to +4
	1 g	+2	−1 to +2
	500 mg	+1·6	−0·8 to +1·6
	200 mg	+1·2	−0·6 to +1·2
	100 mg	+0·8	−0·4 to +0·8
	50 mg	+0·4	−0·2 to +0·4
	20 mg	+0·4	−0·2 to +0·4
	10 mg	+0·2	−0·1 to +0·2
	5 mg	+0·2	−0·1 to +0·2
	2 mg	+0·2	−0·1 to +0·2
	1 mg	+0·1	−0·05 to +0·1
Carat Weights	500 c	+8·0	−4·0 to +8·0
	200 c	+6·0	−3·0 to +6·0
	100 c	+5·0	−2·5 to +5·0
	50 c	+4·0	−2·0 to +4·0
	20 c	+3·0	−1·5 to +3·0
	10 c	+2·0	−1·0 to +2·0
	5 c	+1·0	−0·5 to +1·0
	2 c	+0·8	−0·4 to +0·8
	1 c	+0·6	−0·3 to +0·6
	50/100 c	+0·4	−0·2 to +0·4
	20/100 c	+0·2	−0·1 to +0·2
	10/100 c	+0·2	−0·1 to +0·2
	5/100 c	+0·1	−0·05 to +0·1
	2/100 c	+0·1	−0·05 to +0·1
	1/100 c	+0·1	−0·05 to +0·1
	0·5/100 c	+0·1	−0·05 to +0·1

2. *Liquid Capacity Measures*

Type of Liquid capacity Measure	Denomination of Commercial Capacity measures	Limits of error which may be tolerated at the time of verification and Stamping	Limits of error which may be tolerated at the time of inspection for other purposes
1	2	3	4
		ml	ml.
Cylindrical Measures	2 l	+30	—15 to +30
	1 l	+20	—10 to +20
	500 ml	+15	—7·5 to +15
	200 ml	+8	—4 to +8
	100 ml	+5	—2·5 to +5
	50 ml	+3	—1·5 to +3
	20 ml	+2	—1 to +2
Conical Measures	20 l	+100	—50 to +100
	10 l	+50	—25 to +50
	5 l	+30	—15 to +30
	2 l	+15	—7·5 to +15
	1 l	+10	—5 to +10
	500 ml	+8	—4 to +8
	200 ml	+4	to +4
	100 ml	+3	—1·5 to +3
Special Measures	18·5 l	+100	—50 to +100
	60 ml	+2 to—2	—2 to +2
	30 ml	+1 to—1	—1 to +1

MILLIE

It was reported in the *Daily News* of Perth in August 1963, that a baby born in May 1963 at the Mater Mothers' Hospital in Brisbane was nicknamed Millie, which is the shortened version of milligram. The baby had to wait for more than four months to be introduced to millions as the smallest baby the medical world has known to have survived. Millie weighed about 650 grams at birth and at one time Millie's weight dropped to about 500 g. In August 1963 she weighed 3·375 kilograms.

(Courtesy : W. J. Joyce)

3. Dispensing Measures

Conical Dispensing Measures:—

Conical dispensing measures have the denominations of 200, 100, 50, 20, 10 and 5 ml. The following are the prescribed permissible errors.

Capacity Corresponding to Graduation mark	Permissible Error for Measures Except 50 ml (Squat)			Permissible Error for 50 ml (Squat) Measures		
ml		ml			ml	
200, 180, 160	+3·0	to	—3·0		—	
140, 120 100	+2·0	to	—2·0		—	
90, 80, 70, 60	+1·5	to	—1·5		—	
50, 40	+1·0	to	—1·0	+1·0	to	—1·0
30	+0·8	to	—0·8	+1·0	to	—1·0
20	+0·6	to	—0·6	+0·8	to	—0·8
15	+0·5	to	—0·5			
10, 9	+0·4	to	—0·4	+0·6	to	—0·6
8, 7, 6	+0·3	to	—0·3		—	
5	+0·25	to	—0·25		—	
4	+0·20	to	—0·20		—	
3	+0·16	to	—0·16		—	
2	+0·12	to	—0·12		—	
1	+0·08	to	—0·08		—	

NOTE.—The permissible errors apart from those of the 50 ml (squat) measure, apply to graduation marks corresponding to the capacities stated, irrespective of the nominal capacity of the conical measures concerned.

Beaker Measures.—For beaker measures presented for checking and stamping, the permissible errors shall not exceed + 7 to —7ml for 1000 ml measure and +5 to —5 ml for 500 ml measures.

For 300 ml beaker measure, the following permissible errors are prescribed :—

Graduation mark	*Permissible Error (Verification and Inspection)*		
ml		ml	
300, 250, 200, 180. 150	+3	to	—3
120, 100	+2	to	—2

4. Length Measures

Type of length measures	Denomination of Commercial Length Measures	Limits of error which may be tolerated at the time of verification and stamping			Limits of error which may be tolerated at the time of Inspection for other purposes		
1	3	3			4		
	m		mm			mm	
Metallic Measures	1	+1·0	to	—0·5	+1·0	to	—1·0
	0·5	+0·5	to	—0·25	+0·5	to	—0·5
Wooden Measures	2	+4	to	—2	+4	to	—4
	1	+2	to	—1	+2	to	—2
	0·5	+1	to	—0·5	+1	to	—1

The distance between consecutive 5 centimetre marks shall not have errors positive or negative exceeding 0·25 mm in the case of metallic measures and 1 mm in the case of wooden measures. The error on the full length of the measure, or on the length from zero graduation

1	2	3	4
	to any other graduation, shall not exceed ± 1·0 mm in the case of metallic measures and ± 2mm in the case of wooden measures.		
Folding scale	1	+0·50 to —0·50	+0·50 to —0·50
	0·5	+0·50 to —0·50	+0·50 to —0·50
	In addition, error not to exceed +0·25 to —0·25 mm over any 10cm length of scale.		

Woven Metallic Tape (Tested on a horizontal surface under a tension of one Kilogram)

Measure	50	+20·0 to —20·0	+20·0 to —20·0
	30	+15·0 to —15·0	+15·0 to —15·0
	20	+10·0 to —10·0	+10·0 to —10·0
	15	+7·5 to —7·5	+7·5 to —7·5
	10	+5·0 to —5·0	+5·0 to —5·0
	5	+3·0 to —3·0	+3·0 to —3·0
	2	+1·5 to —1·5	+1·5 to —1·5

In addition, in 20, 30 and 50 m tapes the errors from the beginning of the tape to the lengths specified below shall not exceed the following limits:—

Length m	Permissible Error Verification and Inspection mm
10	+10 to —10
15	+12·5 to —12·5
20	+15 to —15
30	+20 to —20

Steel Tapes (Tested on horizontal surface with a tension of 5 kg for 50, 30, 20, 15 and 10 m tapes and 2 kg for 2 m and 1 m tapes. Permissible errors are the same for verification and inspection).

Length m	
50, 30, 20, 15, 10, 2, 1	Error between any two adjacent mm lines or between consecutive cm lines not to exceed +0·2 to —0·2 mm and between consecutive 10 cm lines or metre lines not to exceed +0·4 to —0·4 mm.

In addition, when measured from zero to the points below, the error in the length of the tape shall not exceed the following limits:—

Mark m	Permissible Error (Verification & Inspection) mm
1	+0·4 to —0·4
2	+0·6 to —0·6
5	+1·0 to —1·0
Any metre mark beyond the first 5 metres.	+1·0 to —1·0 mm for the first 5 metres. +0·5 to —0·5 mm for each additional 5 m or part thereof.

Survey Chains

When measured with a tension of 8 kg every metre length shall be accurate with an error not exceeding +2 to —2 mm. The overall length shall be accurate within the limits shown below:

30m	+8 to —8 mm
20m	+5 to —5 mm

[No. WM-15 (4)/58.]

C. S. RAMACHANDARAN, Jt. Secy.

Adoption of Tex System in Jute Industry

A meeting of the Metric Sub-committee was held on 30 September 1963 under the Chairmanship of Shri G. C. L. Joneja, Jute Commissioner, Calcutta, to consider the proposal for the change-over to the tex system for specifying the yarn count in the jute industry.

At present the grist system is used in the jute industry. The grist is defined as the weight in pounds of 14,400 yards of jute yarn. This is a direct system. The tex is defined as the weight in grams of one kilometre of yarn. Thus both the systems are direct, being the weight for a specified length of yarn. The only difference would be that under the tex system a larger number would represent the yarn count. It was, therefore, generally agreed that the tex system should replace the grist system in three phases.

The first stage would be the use of the existing grist system with the corresponding tex equivalent number given in brackets for expressing yarn counts. This change would be effective from 1 July 1964. The main aims of this stage would be to familiarise industry and the trade with the use of the tex system.

In the second stage the tex system would be the principal system for expressing yarn count with the corresponding grist figures recorded in brackets. This would take effect from 1 July 1965.

In the third stage no reference would be made to the grist system only the tex number would be given. No specified time limit was laid for this stage and it was agreed that this change should be made when the system had come to be understood fully by the trade at home and abroad.

It was also agreed that the rounding off of the tex units would be done only on the unit basis *i.e.* the grist number would be multiplied by 34.45 and the resultant tex number would be rounded off to the nearest whole number.

A small working group was set up to chalk out the phased programme for a change-over in the industry in all aspects of its working to the use of tex system.

Naya Paisa to become Paisa

The Finance Minister stated in the Lok Sabha on 28 November 1963, in reply to a question that the smallest unit of Indian currency will cease to be 'new' (naya) from 1 July 1964. It will be Paisa instead of naya Paisa.

Standards News

(Indian Standards which have a particular bearing on the change-over to the metric system are indicated here. Copies would be available from the Indian Standards Institution, Manak Bhavan, 9, Mathura Road, New Delhi or their Branch Offices at Bombay, Calcutta, Madras and Kanpur).

Revised Indian Standard Specification for Engineers, Pattern Drawing Boards (IS:1444—1963)

The Indian Standards Institution has published the revision of Indian Standard Specification for Engineers' Pattern Drawing Boards (IS:1444—1963), which covers the

requirements for four sizes of engineers' pattern drawing boards designated as D0, D1, D2, and D3.

This standard covers the requirements for four sizes of engineers' pattern drawing boards; and it is intended primarily to assist the small scale sector of the industry in regulating the quality of its production. The sizes of drawing boards have been decided after taking into account the paper sizes included in IS:1064—1961 Specification for Paper Sizes (Revised), and also the sizes of drawings recommended in IS:696—1960 Code of Practice for General Engineering Drawings (Revised). It is proposed to cover in a separate standard students' pattern drawing boards as distinct from the engineers' pattern drawing boards.

Price : Rs. 1.50

Indian Standard for Beam Compasses (IS: 2466—1963)

The Indian Standards Institution has published Indian Standard Specification for Beam Compasses (IS: 2466—1963), which covers the requirements for slow-motion adjustment type beam compasses of sizes 250, 500, 1000 and 1500 mm.

A pair of beam compasses is a drawing instrument with an extension rod used by draughtsmen, engineers and surveyors to draw large circles.

Price : Rs. 1.50

Indian Standard Specification for Stainless Steel Milk Vats (IS: 2336—1963)

The Indian Standards Institution has published Indian Standard Specification for Stainless Steel Milk Vats (IS: 2336—1963), which prescribes the important constructional details and dimensional requirements for stainless steel milk vats of capacities of 500, 1000, 1500 and 2000 litres, designed to collect or store milk prior to its processing or despatch.

The milk vat is used for collection or storage of milk at the reception point and other places in the dairy. The construction of the milk vat is required to be such that the milk remains hygienic and retains all its natural properties.

Price : Rs. 2.00

Indian Standard Specification for Aluminium Milk Vats (IS : 2337—1963)

The Indian Standards Institution has published Indian Standard Specification for Aluminium Milk Vats (IS: 2337—1963), which prescribes the important constructional details and dimensional requirements for aluminium milk vats of 300, 500 and 1000 litres capacity, designed to collect or store milk prior to its processing or despatch.

The milk vat is used for collection or storage of milk at the reception point and other places in the dairy. The construction of the milk vat should be such that the milk remains hygienic and retains all its natural properties.

Price : Rs. 2.00

Indian Standard Specification for Tables for Volume of Cut Sizes of Timber (IS : 2377—1963)

The Indian Standards Institution has published Indian Standard Tables for Volume of Cut Sizes of Timber (IS: 2377—1963), which provides tables for the volume of cut sizes of timber covered by IS:1331—1958 Specification for Cut Sizes of Timber. Lengths from 30 to 500 cm are covered in steps of 10 cm. Volumes are given in cubic metres correct to the fifth place of decimal.

Indian Standard Specification for Cut Sizes of Timber (IS: 1331—1958) was published in 1958 in order to provide guidance to stockists and the timber trade and the general user. The object of the standard was also to channelize the demand for timber. The Committee responsible for the preparation of this standard, therefore, decided that the volume

tables for cut sizes of timber should cover only those sizes specified in IS: 1331—1958.

Price : Rs. 4.00

Indian Standard Specification for Sizes for General Purpose Lathes (IS : 2392—1963)

The Indian Standards Institution has published Indian Standard Sizes for General Purpose Lathes (IS: 2392—1963), which lays down series for swing diameters over bed, swing diameters over carriage and distances between centres for lathes used for general engineering purposes.

This standard has been prepared with a view to assisting the designers in designing new lathes. Variety reduction is one of the objects aimed at by the manufacturers engaged in mass production and it is hoped that this standard will be of help in reducing the prevalent variety of sizes of lathes in the machine tool industry and the designers will use their ingenuity to evolve improved designs within the sizes given in this standard which may prove more economical in the long run.

Standard sizes of machine tools assist the user in determining the types and sizes of machines which should be obtained for planned production. This standard will also help in planning the layout and installation of machines in the workshop. It would further assist in getting early deliveries, and in procuring spares and replacements from sources other than the original maker of the machine tools.

Price : Re. 1.00

Indian Standard Specification for Cylindrical and Taper Pins (IS : 2393—1963)

The Indian Standards Institution has published Indian Standard Specification for Cylindrical and Taper Pins (IS: 2393—1963), which prescribes the requirements for solid cylindrical pins and solid and split taper pins in the diameter range 1.6 to 50 millimetres.

Cylindrical pins and solid and split taper pins are used in shop work and assemblies. Cylindrical pins are used for accurate location and as dowel pins. The taper pins are commonly used for force fit application, such as in knuckle joints.

The taper commonly employed in inch countries is 1 in 48 and that used in metric countries is 1 in 50. Functionally, this difference is quite insignificant. This standard is based on the practice followed by metric countries and specifies a taper of 1 in 50.

Price : Rs. 2.00

Indian Standard Specification for Code of Practice for Selection, Installation and Maintenance of Domestic Water Meters (IS : 2401—1963)

The Indian Standards Institution has published Indian Standard Code of Practice for Selection, Installation and Maintenance of Domestic Water Meters (IS: 2401—1963), which covers the selection, installation and maintenance of inferential and semi-positive types of water meters conforming to IS: 779—1961 Specification for Water Meters (Domestic Type) (*Revised*).

Water meters being available in many designs, with different end connections and varying flow characteristics, due consideration will have to be given when selecting any one type of meter for a particular situation. Moreover, they have to be properly installed so that they may give the desired duty in service without involving frequent repairs and costly maintenance. This code of practice has been prepared with a view to giving useful guidance to consumers and water supply authorities in making proper selection, installation and maintenance of water meters.

Price : Rs. 1.50

Indian Standard Specification for Boiler and Superheater Tubes for Marine and Naval Purposes (IS : 2416—1963)

The Indian Standards Institution has published Indian Standard Specification for

Boiler and Superheater Tubes for Marine and Naval Purposes (IS:2416—1963), which covers the requirements of the following types of boiler and superheater tubes for marine and naval purposes :

(*a*) Cold drawn seamless carbon steel tubes (32 kgf/mm^2 minimum tensile strength);

(*b*) Hot finished seamless carbon steel tubes (32 kgf/mm^2 minimum tensile, strength), and

(*c*) Electrically welded carbon steel tubes (32 kgf/mm^2 minimum tensile strength);

The Institution has earlier published an Indian Standard Specification for Carbon Steel Boiler Tubes and Superheater Tubes, (IS:1914—1961), but it did not cover the special requirements regarding the close tolerance limits for outside diameter and thickness, minimum requirements of elongation test, and higher test pressures as applicable to tubes used for marine and naval purposes. It was, therefore, decided that a separate standard for boiler and superheater tubes should be prepared.

In this standard due consideration has also been given to the need for international coordination with standards being followed in various countries of the world.

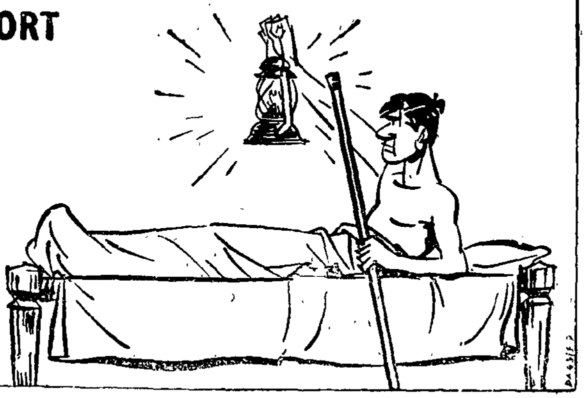
Price : Rs. 3.50

Freedom is in peril, defend it with all your might —Jawaharlal Nehru

DEFENCE OF THE COUNTRY NEEDS CONTINUOUS EFFORT

The external danger that faces us is not of today only. It may last for a considerable time. So the nation will always have to be on its guard. There can be no complacency, no slackening of effort to strengthen defence in every way.

WORK RESOLUTELY



Licensed Manufacturers and Repairers

(*Metric Measures* had been publishing in the past a series of lists of licensed manufacturers, dealers and repairers of weights and measures, weighing and measuring instruments licensed by the Governments in the various States and Union Territories under their Weights and Measures (Enforcement) Acts. To economise on paper, it is possible only to publish lists of licensed manufacturers and repairers.

A feature on statistics of verification and licences issued is also being published in *Metric Measures.*)

STATISTICS OF VERIFICATION OF WEIGHTS ETC. AND LICENCEES

States/Union Territories	Period	Weights	Capacity Measures	Length Measures	Weighing Instruments	Measuring Others Instruments		Total number of		
								Mfrs.	Dealers	Repairers As on 1st day of Jan. 1964
(1) Andhra Pradesh	1 Apr. to 31 July 62	4,56,255	74,480	6,223	8,025	314	—	62	121	36
(2) Assam	1 Apr. 62 to 31 July 63	6,42,529	73,935	7,731	1,068	150		4	69	11
(3) Bihar	1 Apr. 62 to 31 Jan. 63	1,28,211	—	—	19,309	56		30	203	43
(4) Gujarat	1 Apr. 62 to 31 July 63	10,33,838	1,03,371	17,895	1,51,462	844	12	105	586	143
(5) Kerala	1 Apr. 62 to 31 July 62	—	—	—	—	—	—	73	459	142
(6) Jammu & Kashmir	1 Apr. 62 to 31 July 63	1,83,121	113	4,272	1,328	..		1	63	1
(7) Madhya Pradesh	—	—	—	—	—	—	—	—	—	—
(8) Madras	—	—	—	—	—	—	—	—	—	—
(9) Maharashtra	1 Apr. 62 to 31 Mar. 63	18,74,286	5,37,135	33,988	..	..	..	..	..	..
(10) Mysore	1 Apr. 62 to 31 Nov. 62	4,81,354	1,05,253	1,037	59,674	8,420		126	493	92
(11) Orissa	1 Apr. 62 to 31 March 63	4,23,597	86,060	3,089	1,596	2		8	103	6
(12) Punjab	1 Apr. 62 to 30 Sept. 63	15,01,606	84,078	41,826	2,07,347	407	—	10	34	2
(13) Rajasthan	N.A.	—	—	—	—	—	—	—	—	—
(14) Uttar Pradesh	1 Apr. 62 to 31 May 62	5,34,506	7,951	4,702	907	113	—	3	99	18
(15) West Bengal	1 Apr. 62 to 31 Jan. 63	20,03,339	12,762	2,061	88,041	..		116	684	80
(16) A and N Islands	N.A.	—	—	—	—	—	—	—	—	—
(17) Delhi	1 Apr. 62 to 30 Sept. 63	3,32,252	32,001	11,092	43,444	581	—	26	75	22
(18) Himachal Pradesh	1 Apr. 62 to 31 July 63	68,020	7,411	2,523	10,628	1	—	1	25	12
(19) L.M.A. Islands	1 Apr. 62 to Oct. 63	—	—	—	—	—	—	—	—	—
(20) Manipur	1 Apr. 62 to 30 Sept. 63	16,148	3,705	228	390	2,879	Nil	Nil	4	1
(21) Pondicherry	N.A.	—	—	—	—	—	—	—	—	—
(22) Tripura	1 Apr. 62 to 30 July 62	62,050	8464	720	9	8	—	4	85	3

N.A.—Statistics not available as yet.

GUJERAT

The following is the list of Manufacturers and Repairers licensed during the period from 1 February to 30 September, 1963

Manufacturer

Sl. No.	Name and Address of Manufacturer	Details of Articles Manufactured
(1)	Abdullabhai K. Tinwala, Zampa Bazar, Surat.	Conical Capacity Measures.
(2)	Dhiraj Metal Works, Street No. 6, Mill Para, Rajkot.	Dipping type cylindrical Measures.

Repairer

(1) Amery Scale Co., Tower Road, Surendranagar.

(2) Gandhi Anantrai Hirachand, Bazar, Damnagar.

(3) Kansara Ramjibhai Motilal, 1749, Kansara Street, Ahmedabad.

(4) Luhar Chinabhai Odhavji Gohel, Zavedi Bazar, Veraval,

(5) Luhar Manji Dava & Bros, Mota-Bhamodra, (Via. Kandla).

(6) Nutan Scale Works, Near Police Station, Idar.

KERALA

The following are the Manufacturers and Repairers licensed during period 1-7-63 to 30-9-63.

Sl. No.	Name and Address of Manufacturers	Details of Articles Manufactured
(1)	P. Abdulla, Chalil Road, Tellicherry.	Cylindrical Capacity Measures.
(2)	A. Abdulkaram, Kadayaravilakam, Thaiveedu, Balarampuram.	Cylindrical Capacity Measures and Beam Scales Class C & D—Coincal Capacity Measures.
(3)	Keerikandy Kuttan, Kallai Tin Mart, Near Kallai Rly, Stn. Kallai P.O.	Cylindrical and Capacity Measures.
(4)	National Switch Board Works, Bank Road, Calicut.	Wooden Length Measures.
(5)	Thomas George, Periyar Metal Products, Palai, Kottayam.	Cylindrical Capacity Measures.

REPAIRERS

(1) C.A. Abdulla, Churakattu Veedu, Iritty P.O., Via, Tellicherry.

(2) V.V. Cherian & V.V. Kunchako, Vazhapallykalam Market Ward, Alleppey.

(3) K. Chidambaram Asari, K. C. Mechanical Works, East of Patteri Illam, Thiruvambady.

(4) S. Krishnan Nair, Puthenpurlake House, Peermade.

(5) K. Sivankutty Asari, Alleppey Metal Industries, Near Stone Bridge, Alleppey.

TRIPURA

Manufacturers and Repairers licensed during June and July 1963.

MANUFACTURER

(1) National Mechanical Kasari Patti, P.O. Agartala, Tripura.

(2) Tirthamayee Aluminium Arundhutinagar, P. O. Agartala, Tripura.

REPAIRER

(1) Burmah Oil Company (P)., P. O. Digboi, Distt. Lakhimpur, Assam.

(2) National Mechanical Kasari Patti, P. O. Agartala, Tripura.

M140DPD—GIPF.

TYPICAL METRIC PRICING UNITS FOR WHOLESALE TRANSACTIONS

Serial No.	Commodity	Metric Unit
(1)	*Gold*	10 grams (g)
(2)	**Grocery and Confectionery**	1 kilogram (kg)
	Biscuits, sweetmeats, cardamoms.	
	Textiles and Textile Fibres	
	Cotton yarn, damaged and seconds cloth, raw silk, rayon, silk yarn, raw wool, wool manufacturers (when sold by weight).	
	Paints & Chemicals	
	Paint (if sold by weight), indigo, liquid chlorine.	
	Hides, Skins & Leather	
	Raw hides, leather (hides and skins).	
	Metals	
	Silver, aluminium sheets, strips and circles, copper and brass wires and utensils.	
	Miscellaneous	
	Tea, meat, camphor tablets, mica.	
(3)	**Grains and Pulses**	1 quintal (q) (100 kilograms)
	Rice, wheat, jowar, arhar, moong, masur, gram.	
	Spices	
	Black pepper, mustard, chillies, dhania, dalchini, turmeric, betelnuts.	
	Plantation Products	
	Rubber, cashewnuts, cashew kernels, tobacco (raw and manufactured).	
	Forest Products	
	Lac and lac products, gums, myrobalans, galnuts, soapnuts.	
	Textiles & Textile Fibres	
	Raw jute, raw hemp, coir yarn.	
	Oils, Oilseeds & Oilcakes	
	Vegetable oils, oilseeds, oilcakes.	
	Non-Ferrous Metals	
	Aluminium : ingots, bars, blocks, slabs, billets.	
	Lead : ingots, sheets and strips.	
	Copper : ingots, blooms, slabs, cakes, tiles, bricks, billets, blisterbars and wirebars, rods, sections and pipes, plates, sheets and strips, circles.	
	Brass : ingots, rods, sections, pipes, sheets, strips, circles.	
	Zinc : ingots, sheets, strips.	
	Tin : blocks.	
	Chemicals	
	Caustic soda, bleaching powder, glycerine, soaps, paper salt.	
	Others	
	Sugar, gur, ice, fish, sugarcane, vegetables, tamarind.	
(4)	**Minerals**	one metric tonne (t) (1,000 kilograms)
	Iron ore, manganese ore, bauxite, coal.	
	Iron & Steel	
	Pig iron, iron and steel manufactures, semis (billets for rerolling etc.)	
(5)	Cloth (mill, handloom, silk, rayon and woollen cloth).	1 metre (m)
(6)	Jute carpets, coir mats and mattings, sheet glass.	one square metre (m^2)
(7)	Timber.	one cubic metre (m^3)
(8)	Paints (when sold by measure), spirits.	one litre (l)

Weights

(1) In place of the present units of seer, pound, rattal, viss etc., use the kilogram.

(2) In place of the tola, use the gram or 10 grams.

(3) In place of maund or corresponding unit, use the quintal *i.e.*, 100 kg.

Capacity Measures

In place of seer or gallon or any other measure use the litre.

Length Measures

(1) Use the metre in place of yard or foot and the centimetre in place of inch.

Square Measures

(1) Use the square metre in place of square yard or square foot, and square centimetre in place of square inch.

Cubic Measures

(1) Use the cubic metre in place of cubic yard or cubic foot and cubic centimetre in place of cubic inch.

Packaging

It is advantageous if sizes of packages correspond to series of commercial weights and measures prescribed.

These are: 50 kg, 20 kg, 10 kg, 5 kg, 2 kg, 1 kg, 500 g, 200 g, 100 g, 50 g, 20 g, 10 g, 5 g, 2 g, 1 g, and so on.

TYPICAL PRICING UNITS FOR RETAIL TRADE

Serial No.	Commodity	Metric Unit for Use
(1)	Foodgrains, cereals, pulses, spices, ghee, bread, vegetables, meat, fish, sweetmeats, tea, coffee, sugar, salt.	1 kg
(2)	Oil for cooking	1 kg or 1 litre depending upon prevalent practice.
(3)	Fruits	1 kg or number depending upon prevalent practice.
(4)	Milk	1 litre
(5)	Cloth and related materials	1 metre
(6)	Prepackaged materials	Preferably sizes corresponding to series of commercial weights and measures.

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